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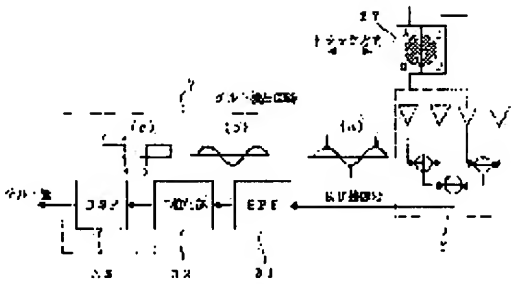
(54) DISK DEVICE AND ITS TILT DETECTING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To precisely detect the amount of disk tilts without using a tilt sensor.

SOLUTION: The amount of the disk tilts is detected based on the asymmetry between an upper and a lower wobble signals included in the output RF difference signal of an optical pickup 5 or based on the symmetry in amplitude of an upper and a lower land prepit signals included in the output RF difference signal. Further, the amount of the disk tilts is detected by the evaluation of the symmetry in the upper peak and lower peak values of the output RF difference signal.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a disk unit and the tilt detection approaches, such as for example, a DVD-R drive and a DVD-RW drive.
[0002]
[Description of the Prior Art] Generally, when the optical disk set in the optical disk unit which reads a signal in optical disks, such as CD (Compact Disc) and DVD (Digital Versatile Disc), and is reproduced has a tilt angle (inclination), the regenerative signal which read from the optical disk and was reproduced deteriorates.
[0003] Since it is necessary to shorten wavelength of a laser beam in order to make the diameter of a spot of a laser beam small, and to enlarge the numerical aperture NA of an objective lens to perform high density record like DVD-R and DVD-RW especially, the margin to a tilt angle becomes small.
[0004] That is, even if the optical disk leans slightly, big degradation of playback quality is caused. Therefore, in the optical disk unit, the amount of a tilt is detected to high degree of accuracy, and it is made indispensable to apply amendment to this amount of tilt detection. The method of comparing with an objective lens to pickup, forming a tilt sensor in the approach of detecting the amount of disk tilts, and measuring the inclination of a disk directly etc. is in use.
[0005]
[Problem(s) to be Solved by the Invention] However, the method of forming a tilt sensor in pickup had the problem that a big tooth space was needed while it needed to incorporate the components of the tilt sensor itself in pickup and its components mark increased.
[0006] This invention aims at offer of the disk regenerative apparatus which can detect the amount of disk tilts to high degree of accuracy, and its tilt detection approach, without having been made in order to solve such a technical problem, and using a tilt sensor.
[0007]
[Means for Solving the Problem] In order to attain the above-mentioned object, the disk unit of invention according to claim 1 is characterized by providing the optical pickup which reads the signal of said disk and outputs RF difference signal, and the tilt detector which evaluates the symmetry of the upper and lower sides of said RF difference signal, and detects the amount of disk tilts in the disk unit which plays the disk of a wobble run DOPURI pit method.
[0008] The disk unit of invention according to claim 2 is characterized by providing the optical pickup which reads the signal of said disk and outputs RF difference signal, and the tilt detector which evaluates the symmetry of the wobble signal of the upper and lower sides included in said RF difference signal, and detects the amount of disk tilts in the disk unit which plays the disk of a wobble run DOPURI pit method.
[0009] The disk unit of invention according to claim 3 is characterized by providing the optical pickup which reads the signal of said disk and outputs RF difference signal, and the tilt detector which evaluates the amplitude symmetry of the run DOPURI pit signal of the upper and lower sides included in said RF difference signal, and detects the amount of disk tilts in the disk unit which plays the disk of a wobble run DOPURI pit method.
[0010] The disk unit of invention according to claim 4 is characterized by providing the optical pickup which reads the signal of said disk and outputs RF difference signal, and the tilt detector which evaluates the symmetry of the peak value of the upper and lower sides of said RF difference signal, and detects the amount of disk tilts in the disk unit which plays the disk of a wobble run DOPURI pit method.
[0011] According to this invention, without using a tilt sensor, the amount of disk tilts can be detected to high degree of accuracy, and it becomes possible by the ability eliminating a tilt sensor from an optical pickup to offer a small and lightweight disk unit.
[0012]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing. Drawing 1 is drawing showing the configuration of the disk unit which is 1 operation gestalt of this invention.

[0013] With the disk actuator 3 where this disk unit drives the optical disks 1, such as DVD-R and DVD-RW, as shown in drawing 1 The optical pickup 5 which irradiates a laser beam to the recording surface of an optical disk 1, and a signal, and changes the laser reflected light from the 1st page of an optical disk into an electrical signal, and outputs RF difference signal, [write in or] The pre amplifier 6 which amplifies RF difference signal outputted from this optical pickup 5, and is introduced into the tilt detector 7 and a digital disposal circuit 8, The tilt detector 7 which detects the amount of disk tilts based on the output RF difference signal of pre amplifier 6, It has the digital disposal circuit 8 which processes the output RF difference signal of pre amplifier 6, and performs data playback etc., the tilt amendment device 10 in which tilt amendment corresponding to the amount of disk tilts detected by the tilt detector 7 is performed, and the controller 11 which performs the whole control, and is constituted.

[0014] An optical pickup 5 consists of a laser light source 21, a collimate lens 22, prism 23, a liquid crystal device 24, an objective lens 25, a condenser lens 26, a quadrisection light detector 27, etc. A collimate lens 22 and prism 23 are passed, it is condensed with an objective lens 25, and the laser beam of a laser light source 21 is irradiated by the recording surface of an optical disk 1. At the time of read-out, the reflected lights from the recording surface of an optical disk 1 are collected with an objective lens 25, are caught by the quadrisection light detector 27 through prism 23 and a condenser lens 26, are changed into an electrical signal, and are outputted as an RF difference signal.

[0015] RF difference signal outputted from an optical pickup 5 is inputted into a digital disposal circuit 8 through pre amplifier 6, is changed into digital data by this digital disposal circuit 8, through an error correction etc., serves as playback data and is outputted. Moreover, the output RF difference signal of pre amplifier 6 is inputted into the tilt detector 7, and measurement of the amount of tilts is performed in this tilt detector 7.

[0016] The configuration of the tilt detector 7 is shown in drawing 2 . As this tilt detector 7 is a circuit which detects the amount of tilts based on the asymmetry of the wobble signal of the upper and lower sides included in the output RF difference signal ((A+D)-(B+C)) of pre amplifier 6 and is shown in drawing 2 BPF31 which passes the signal (b) of a wobble frequency component from the output RF difference signal (a) of pre amplifier 6 (band pass filter), The binarization section 32 which carries out binarization of the wobble signal (b) which passed BPF31, Binarization section 32 the average value of the difference of the on-level period of a wobble signal (c) and off level period by which binarization was depended and carried out, or a difference etc. as a value which shows the asymmetry of said wobble signal It consists of DSPs (digital signal processor)33 equipped with the function which computes the amount of disk tilts based on this.

[0017] Next, actuation of detection of the amount of disk tilts by this tilt detector 7 is explained.

[0018] Drawing 3 shows correlation with the physical format of the recording surface of the optical disks 1, such as DVD-R and DVD-RW, and RF difference signal wave form introduced into the tilt detector 7, and RF difference signal wave form (continuous line) in case, as for drawing 3 (b), RF difference signal wave form in the case of the amount zero of tilts exists and, as for drawing 3 (c), a tilt exists is shown, respectively. This disk 1 has adopted the wobble run DOPURI pit method as a physical format. A wobble land groove method is a method which records a mark on the truck of both the truck (groove truck) 41 of concave, and the truck (land truck) 42 of a convex formed in the disk side, as shown in drawing 3 (a). The minute wave called a wobble 43 is formed in the truck on the predetermined frequency, and it is supposed based on the signalling frequency acquired by detecting this wobble 43 that it is possible to perform rough lead channel PLL drawing in.

[0019] Moreover, the pit (run DOPURI pit) 44 as address information is formed in the land truck 42 at the time of media manufacture. Furthermore, in two land trucks 42 which adjoin each other across the groove truck 41, the run DOPURI pit 44 is arranged by turns in the location equivalent to the top of the wobble 43 of the periphery of the above-mentioned groove truck 41, and the top-most vertices of a bottom product.

[0020] If the amount of tilts is zero when the groove truck 41 of the disk side which has such a physical format is scanned by the optical beam spot 45, RF difference signal as shown in drawing 3 (b) will be inputted into the tilt detector 7.
[0021] In this RF difference signal, the component (wobble signal) according [accord / 51a and 51b / 52a / the component (run DOPURI pit signal) of the run DOPURI pit 44 and 52b] to a wobble 43 is shown. When the amount of disk tilts is zero, run DOPURI pit signal 51a and wobble signal 52a which appear above main level, run DOPURI pit signal 51b which appears in the bottom, and wobble signal 52b are symmetrical, namely, the relation of Tu=TdLu=LdAu=Ad is realized.
[0022] On the other hand, when a tilt is in a disk 1, RF difference signal as shown in the continuous line of drawing 3 (c) will be inputted into the tilt detector 7 from pre amplifier 6. In addition, since a comparison is easy, a dotted line shows RF difference signal in the case of the amount zero of tilts.
[0023] As shown in this drawing, when a tilt exists, symmetric property with run DOPURI pit signal 53a and wobble signal 54a which appear above main level, run DOPURI pit signal 53b which appears in the bottom, and wobble signal 54b collapses. In the example of drawing 3 (c), it becomes Tu>TdLu>LdAu>Ad. Of course, these relation can serve as Tu<TdLu<LdAu<Ad with the sense of a tilt.
[0024] The tilt detector 7 shown in drawing 2 is a configuration in the case of obtaining the difference (or average value per unit time amount of the difference) and its size relation between Tu and Td as a detection result of the amount of disk tilts. In this tilt detector 7, a wobble frequency component (b) by BPF (band pass filter)31 from the output RF difference signal (a) of pre amplifier 6 Namely, ejection, After carrying out binarization of this in the binarization section 32, while searching for the difference (or average value per unit time amount of the difference) of H level time amount of a binarization signal (c), and L level time amount as an amount of disk tilts by DSP33 The sense of a tilt is judged from the relation of the merits and demerits of H level time amount and L level time amount.
[0025] The detection result of this tilt detector 7 is given to a controller 11, and a controller 11 controls the tilt amendment device 10 based on this tilt detection result.
[0026] The device in which the operation effectiveness equivalent to leaning an optical pickup and an objective lens by negating the comatic aberration of the laser beam which arranges a liquid crystal device in the device in which for example, the pickup itself is made to incline mechanically, the device in which the objective lens of an optical pickup is made to incline, and an optical pickup, and is penetrated at the time of tilt generating in the tilt amendment device 10 is acquired etc. may be the thing of what kind of structure.
[0027] In this way, according to this operation gestalt, by obtaining a tilt detection result based on the asymmetry of the wobble signal of the upper and lower sides included in the output RF difference signal of an optical pickup 5, an optical pickup is enabled to eliminate a tilt sensor and it becomes possible to offer a small, lightweight, and cheap disk unit.
[0028] By the way, although the tilt detector 7 shown in drawing 2 detects the amount of disk tilts based on the asymmetry of an up-and-down wobble signal, as shown in drawing 3 (c), the asymmetry by the disk tilt appears also in the amplitude of the run DOPURI pit signal similarly included in the peak value and RF difference signal of the upper and lower sides of RF difference signal.
[0029] Then, the circuitry of the tilt detector which detects the amount of disk tilts based on the asymmetry of the peak value of the upper and lower sides of these RF difference signal or the amplitude of a run DOPURI pit signal is explained below.
[0030] Drawing 4 is the example of a configuration of the tilt detector which detects the amount of disk tilts based on the peak value of the upper and lower sides of RF difference signal.
[0031] In this tilt detector 107, RF difference signal outputted from pre amplifier 6 is introduced into the upside peak hold circuit 34 and the bottom peak hold circuit 35, respectively. As a result, the upside peak value Au and the bottom peak value Ad of RF difference signal are extracted, respectively. A subtractor 61 subtracts the bottom peak value Ad from the upside peak value Au, and outputs the difference signal to DSP36. As a value which shows the asymmetry of the peak value of the upper and lower sides of this difference signal of RF difference signal, DSP36 computes the amount of disk tilts

based on this, and supplies that result to a controller 11.
[0032] Drawing 5 is the example of a configuration of the tilt detector which detects the amount of disk tilts based on the asymmetry of the amplitude of a run DOPURI pit signal.
[0033] In this tilt detector 207, first, the signal of a wobble frequency component is extracted from RF difference signal outputted from pre amplifier 6 by BPF37, and it is introduced into the upside peak hold circuit 38 and the bottom peak hold circuit 39, respectively. The upside peak hold circuit 38 detects the peak value of a wobble signal upside, and supplies it to a subtractor 62. A subtractor 62 outputs the amplitude Lu of an upper run DOPURI pit signal by subtracting the upside peak value of the above-mentioned wobble signal from the output of the upside peak hold circuit 34 which detects the peak value of RF difference signal upside.
[0034] On the other hand, the bottom peak hold circuit 39 detects the peak value of the wobble signal bottom, and supplies it to a subtractor 63. A subtractor 63 outputs the amplitude Ld of a lower run DOPURI pit signal by subtracting the bottom peak value of the above-mentioned wobble signal from the output of the bottom peak hold circuit 35 which detects the peak value of RF difference signal bottom.
[0035] Difference is further taken with a subtractor 64 and, as for the output of said two subtractors 62 and 63, the difference signal is outputted to DSP36. As a value which shows the asymmetry of the amplitude of the run DOPURI pit signal of the upper and lower sides of this difference signal, DSP36 computes the amount of disk tilts based on this, and supplies that result to a controller 11.
[0036] As mentioned above, although three tilt measuring methods from RF difference signal were explained, of course, modification can be variously added within limits which the method of performing tilt measurement from RF difference signal is not limited to the above-mentioned thing, and do not deviate from the summary of this invention.
[0037]
[Effect of the Invention] As explained above, the amount of disk tilts can be detected with a sufficient precision by according to this invention, evaluating the symmetry of the upper and lower sides of RF difference signal, and detecting the amount of disk tilts, without using a tilt sensor, and small and lightweight-ization of a disk unit can be attained by the ability eliminating a tilt sensor from an optical pickup.

[Translation done.]

[Claim(s)]

[Claim 1] The disk unit characterized by providing the optical pickup which reads the signal of said disk and outputs RF difference signal in the disk unit which plays the disk of a wobble run DOPURI pit method, and the tilt detector which evaluates the symmetry of the upper and lower sides of said RF difference signal, and detects the amount of disk tilts.

[Claim 2] The disk unit characterized by providing the optical pickup which reads the signal of said disk and outputs RF difference signal in the disk unit which plays the disk of a wobble run DOPURI pit method, and the tilt detector which evaluates the symmetry of the wobble signal of the upper and lower sides included in said RF difference signal, and detects the amount of disk tilts.

[Claim 3] The disk unit characterized by providing the optical pickup which reads the signal of said disk and outputs RF difference signal in the disk unit which plays the disk of a wobble run DOPURI pit method, and the tilt detector which evaluates the amplitude symmetry of the run DOPURI pit signal of the upper and lower sides included in said RF difference signal, and detects the amount of disk tilts.

[Claim 4] The disk unit characterized by providing the optical pickup which reads the signal of said disk and outputs RF difference signal in the disk unit which plays the disk of a wobble run DOPURI pit method, and the tilt detector which evaluates the symmetry of the peak value of the upper and lower sides of said RF difference signal, and detects the amount of disk tilts.

[Claim 5] The tilt detection approach of the disk unit characterized by evaluating the symmetry of the upper and lower sides of RF difference signal outputted from the optical pickup at the time of playback of the disk of a wobble run DOPURI pit method, and detecting the amount of disk tilts based on this assessment result.

[Claim 6] The tilt detection approach of the disk unit characterized by evaluating the symmetry of the wobble signal of the upper and lower sides included in RF difference signal outputted from the optical pickup at the time of playback of the disk of a wobble run DOPURI pit method, and detecting the amount of disk tilts based on this assessment result.

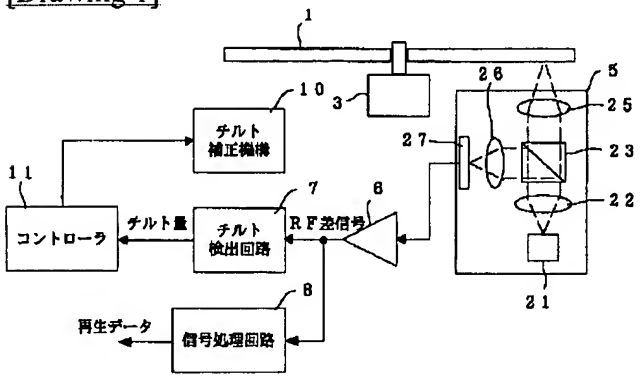
[Claim 7] The tilt detection approach of the disk unit characterized by evaluating the amplitude symmetry of the run DOPURI pit signal of the upper and lower sides included in RF difference signal outputted from the optical pickup at the time of playback of the disk of a wobble run DOPURI pit method, and detecting the amount of disk tilts based on this assessment result.

[Claim 8] The tilt detection approach of the disk unit characterized by evaluating the symmetry of the peak value of the upper and lower sides of RF difference signal outputted from the optical pickup at the time of playback of the disk of a wobble run DOPURI pit method, and detecting the amount of disk tilts based on this assessment result.

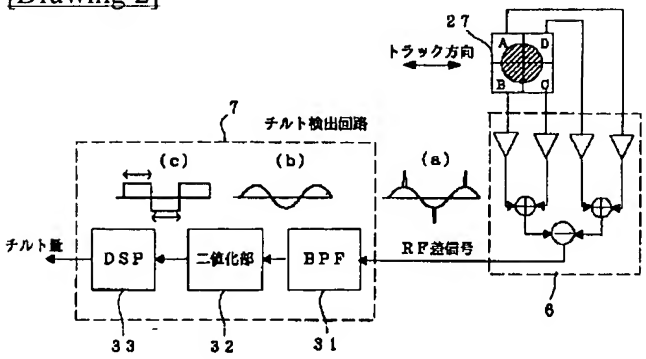
* NOTICES *

DRAWINGS

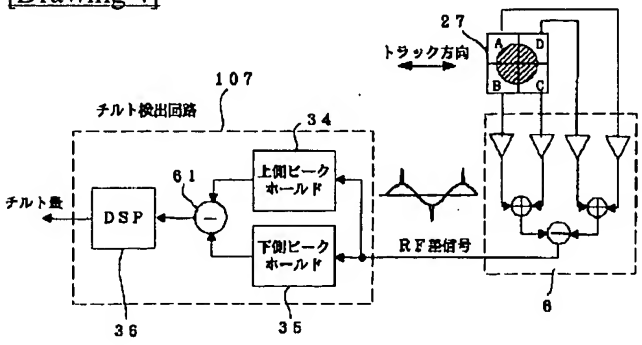
[Drawing 1]



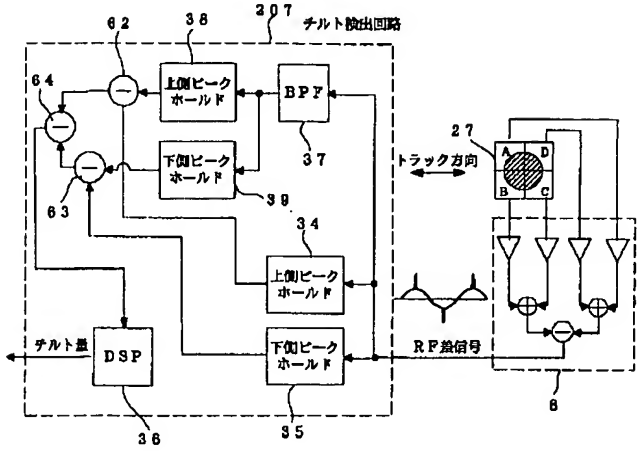
[Drawing 2]



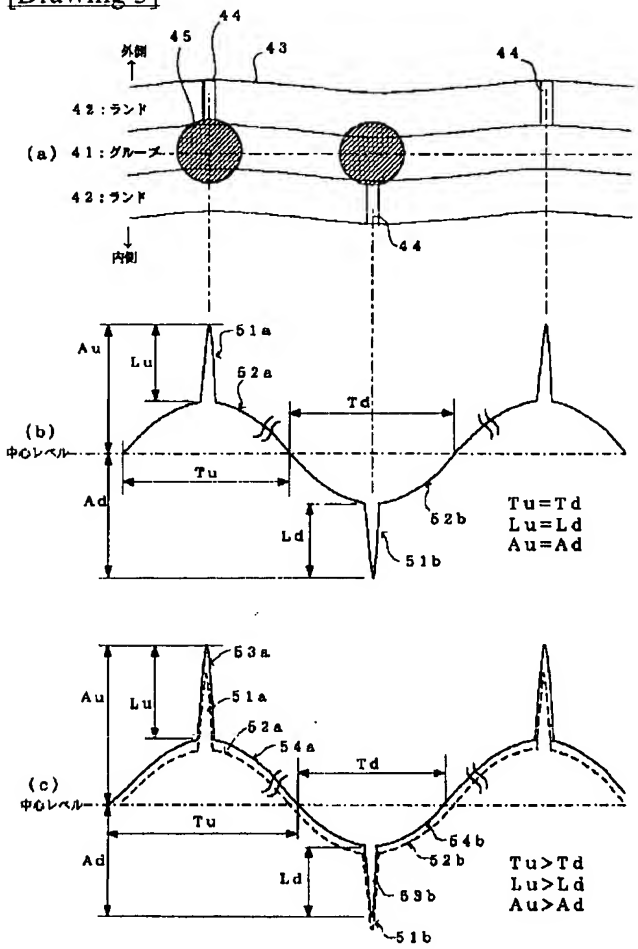
[Drawing 4]



[Drawing 5]



[Drawing 3]



[Translation done.]